

AEROLOGICAL OBSERVATIONS

[Aerological Division, D. M. LITTLE, in charge]

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Resultant-wind directions in the lower levels of the upper air showed marked northerly and northwesterly tendencies over all areas east of the Rocky Mountains and north of the 35th parallel, where mean surface temperatures were decidedly below normal. Elsewhere, and particularly in the far Northwest, the resultant winds were southerly and southwesterly, and mean temperatures much higher than normal. Precipitation was excessive in northern California and the far Northwest, where southwesterly winds prevailed during March. These resultant winds, controlled to some extent by the position of the Aleutian low, were largely composed of greatly modified Polar Pacific air and Tropical Pacific air.

Heavy rainfall in the Rio Grande Valley of Texas occurred in association with predominately southerly and southeasterly upper-air resultant winds and moist Tropical Gulf air (chart VIII). The heavy precipitation in New England and the northern Plains States occurred in areas where resultant winds, shown on charts VIII, IX, X, and XI, were definitely from the northwest quadrant. However, during the periods when precipitation occurred, southerly winds were indicated by the upper-air isobars.

Mean humidities were high almost generally except in the Southwest, where El Paso, Tex., Phoenix, Ariz., and Oklahoma City, Okla., reported low monthly means. At Oklahoma City, Okla., where March rainfall was but 1 percent of normal, the average mean relative humidity of all levels was 41 percent, while northward, where precipitation was 150 percent of normal, the Omaha, Nebr., average mean humidity was 68 percent.

Surface temperatures over the country during March were divided nearly equally along the ninety-fifth meridian, with subnormal means to the eastward and above-normal means to the westward. In those areas where resultant-wind directions were decidedly northwesterly it was noted that below-normal surface mean temperatures occurred. Also, these wind directions were more northerly than normal, being outstanding as far south as Nashville, Tenn., at 1.5 kilometers, and Atlanta, Ga., at 3 kilometers. In the West, where mean temperatures were above normal, the resultant directions at 1.5 kilometers were more southerly than normal, especially at Oakland, Calif., and Medford, Oreg. Resultant velocities were greater than normal at 1.5 and 3 kilometers, except over the Southwest and California, where they were less than normal. The largest negative departure from normal was -2.3 meters per second at San Diego, Calif., at 1.5 kilometers, and the greatest positive departure was $+3.5$ meters per second over Seattle, Wash., at 3 kilometers.

The month showed a slight northward recession of the freezing line at the ground since February. Freezing temperatures (0° C.) covered an area north of a line extending from Lakehurst, N. J., Joliet, Ill., and Bismarck, N. Dak. However, the surface of mean freezing temperature in the

free air was found to slope upward rather abruptly until it attained an elevation of 2 kilometers at an average geographical distance of 300 miles south of the location of the freezing line on the ground. The slope of this mean freezing surface then flattened out and intersected the 3-kilometer level along a line that extended from central Georgia, over east-central Texas, southwestern Colorado, to a point north of central California. The maximum height (4,080 meters) above which freezing temperatures occurred was over Miami, Fla., being only 60 meters higher than in the preceding month.

March was generally warmer throughout the upper air below 10 kilometers than during February. However, at Minneapolis, Minn., Joliet, Ill., Sault Ste. Marie, Mich., Buffalo, N. Y., Lakehurst, N. J., and Washington, D. C., lower mean temperatures occurred at most levels than in the preceding month. But in the levels above 10 kilometers, March was colder than February, while at Fairbanks, Alaska (the general source region of Polar Pacific air), March temperatures were lower at all levels.

Mean free-air pressures for March showed some seasonal increases over the preceding month. The magnitude of the March mean pressure gradients for all standard levels was found to increase steadily with altitude from the surface until the difference between the Sault Ste. Marie, Mich., low and the Miami, Fla., high reached a maximum of 35 millibars at 7 and 8 kilometers. The steepest mean pressure gradient for any level over the country occurred in the East at approximately 8 kilometers, with the greatest concentration of mean isobars between Lakehurst, N. J., and Charleston, S. C. However, steep mean pressure gradients were also particularly outstanding over Virginia and North Carolina at 10, 11, and 12 kilometers, and strong resultant-wind velocities (table 2) occurred in this area, with the highest speed (36.1 meters per second) over Greensboro, S. C., at 10 kilometers.

MONTHLY MEAN ISENTROPIC CHART ¹

The mean isentropic chart $\theta=298^{\circ}$ (chart XII) for March 1940, is characterized by a rather uniform south-north moisture gradient over most of the country, but with considerably warmer and moister air prevailing over the West than over the East. The departures of precipitation over the northern part of the country correspond fairly well to this pattern, except for the large excesses over the North Atlantic States. It will be noted that the boundary between positive and negative departures is almost coincident with the position of the "nose" in the moisture lines.

Strong west-northwest flow is seen to predominate over most of the country, with the northern tips of anticyclonic eddies indicated over Florida, Arizona, and Texas.

¹ Prepared by the Division of Research and Education.

TABLE 1.—Mean free-air barometric pressures (P) in mb., temperatures (T) in ° C., and relative humidities (R. H.) in percent, obtained by airplanes and radiosondes during March 1940¹

Altitude (meters) m. s. l.	Stations and elevations in meters above sea level																											
	Albuquerque, N. Mex. (1620 m)				Atlanta, Ga. (300 m)				Billings, Mont. (1,089 m)				Bismarck, N. Dak. (505 m)				Boise, Idaho (864 m)				Buffalo, N. Y. (220 m)				Charleston, S. C. (14 m)			
	Number of obs.	P	T	R. H.	Number of obs.	P	T	R. H.	Number of obs.	P	T	R. H.	Number of obs.	P	T	R. H.	Number of obs.	P	T	R. H.	Number of obs.	P	T	R. H.	Number of obs.	P	T	R. H.
Surface	31	835	7.9	39	31	980	7.2	76	31	889	2.0	72	31	957	-5.2	91	31	916	5.4	73	31	988	-3.9	84	31	1,014	9.1	81
500					31	957	7.9	70													31	954	-4.8	75	31	957	11.3	66
1,000					31	901	7.3	64					31	899	-4.1	82	31	901	7.6	67	31	894	-7.0	78	31	901	9.5	60
1,500					31	848	6.3	57	31	845	2.1	68	31	844	-5.6	77	31	848	5.8	60	31	838	-7.9	77	31	848	6.8	58
2,000	31	798	8.4	38	31	797	4.2	54	31	794	0.1	67	31	791	-7.2	74	31	797	2.0	61	31	786	-9.6	73	31	798	4.8	52
2,500	31	750	5.1	37	31	749	1.7	52	31	745	-3.0	68	31	742	-8.9	73	31	749	-1.9	63	31	737	-11.5	71	31	751	2.7	49
3,000	31	706	1.2	38	31	704	-0.8	49	31	700	-6.5	70	31	695	-10.4	71	31	703	-5.4	65	31	690	-13.7	66	31	705	0.5	47
4,000	30	622	-6.7	40	31	620	-6.2	44	31	615	-13.4	74	31	610	-15.6	68	31	618	-11.4	65	31	604	-18.9	63	31	622	-5.1	42
5,000	30	546	-13.9	40	31	545	-12.9	41	31	538	-19.9	74	30	534	-22.0	65	30	542	-17.6	60	30	528	-24.5	59	31	547	-11.6	39
6,000	30	478	-20.0	38	31	478	-20.0	41	31	470	-27.1	70	27	465	-29.0	64	30	473	-24.2	55	30	459	-31.1	57	31	479	-18.5	37
7,000	30	416	-28.7	36	31	416	-27.8	39	31	408	-34.9	66	27	403	-36.8	60	30	412	-32.1	53	30	398	-38.6	54	31	418	-25.9	37
8,000	30	362	-36.4	36	30	362	-35.6	38	31	353	-42.7		25	348	-45.0		30	356	-39.9	53	30	343	-45.4		30	364	-34.0	37
9,000	30	312	-44.1		30	313	-43.4		31	303	-50.2		23	299	-53.1		30	307	-47.6		29	295	-51.2		30	314	-41.6	
10,000	30	269	-51.1		30	268	-50.6		30	260	-56.2		21	255	-59.2		30	263	-54.4		29	253	-54.6		30	270	-49.3	
11,000	30	230	-56.7		29	230	-56.7		30	222	-59.5		19	218	-61.4		29	225	-59.5		26	216	-53.0		28	232	-55.4	
12,000	30	196	-60.0		29	196	-59.1		30	189	-59.7		18	185	-59.7		29	192	-60.9		24	184	-53.2		27	198	-58.7	
13,000	30	167	-69.4		28	167	-68.9		27	161	-67.4		14	158	-67.4		29	163	-69.1		23	157	-62.8		27	169	-59.2	
14,000	28	142	-69.9		28	142	-69.4		26	137	-66.5		11	134	-66.6		28	139	-67.3		21	134	-53.1		26	144	-60.8	
15,000	25	121	-61.6		28	121	-62.3		25	117	-64.6		9	114	-66.9		25	118	-67.3		21	114	-53.5		23	123	-62.7	
16,000	22	103	-63.0		26	103	-64.2		22	100	-66.6		8	98	-66.9		19	101	-68.4		19	97	-54.1		21	104	-64.9	
17,000	19	87	-63.1		20	87	-64.1		15	85	-66.5						13	86	-68.2		11	82	-54.1		19	78	-65.8	
18,000	12	74	-62.9		16	74	-62.8		7	73	-66.3						5	73	-67.4						13	75	-65.4	
19,000					7	63	-60.5																		8	64	-63.6	

Altitude (meters) m. s. l.	Stations and elevations in meters above sea level																											
	Denver, Colo. (1,616 m.)				El Paso Tex. (1,193 m.)				Ely, Nev. (1,908 m.)				Fairbanks, Alaska (153 m.)				Joliet Ill. (178 m.)				Juneau, Alaska (49 m.)							
	Obs.	P.	T.	R.H.	Obs.	P.	T.	R.H.	Obs.	P.	T.	R.H.	Obs.	P.	T.	R.H.	Obs.	P.	T.	R.H.	Obs.	P.	T.	R.H.				
Surface	31	835	1.6	74	31	880	12.1	32	29	808	0.6	67	31	989	-8.2	60	28	994	-1.3	86	31	1,004	1.6	79				
500													31	947	-7.9	62	28	954	-1.6	78	31	949	-0.3	79				
1,000													31	888	-9.6	63	28	896	-3.6	68	31	891	-3.3	81				
1,500					31	849	13.6	32					31	832	-10.7	65	28	841	-4.2	68	31	836	-6.2	84				
2,000	31	796	4.0	64	31	799	10.2	32	29	799	2.1	63	31	783	-13.0	65	28	789	-6.1	64	31	784	-9.2	84				
2,500	31	748	1.6	60	31	752	6.4	32	29	751	.9	58	31	730	-15.9	64	28	740	-8.1	62	31	735	-12.1	84				
3,000	31	703	-1.9	59	31	707	2.8	32	29	705	-2.9	59	31	682	-18.9	63	28	693	-10.4	63	30	688	-15.3	83				
4,000	31	619	-9.1	58	31	624	-4.2	34	29	621	-9.3	55	31	595	-26.0	62	28	608	-15.1	62	29	601	-21.4	85				
5,000	31	543	-15.8	57	31	549	-11.3	34	29	545	-15.5	51	30	518	-33.1	62	28	532	-21.3	61	26	524	-28.0	76				
6,000	31	475	-22.8	56	31	481	-18.2	33	29	476	-22.8	50	29	448	-39.7	58	28	464	-28.5	61	21	455	-35.0	73				
7,000	31	413	-30.8	54	31	420	-26.1	32	28	414	-30.6	48	29	386	-46.2		24	403	-36.5	61	18	393	-41.7					
8,000	31	358	-38.8	53	31	365	-34.1	31	28	359	-38.4	48	27	332	-61.5		23	349	-42.4		16	338	-48.1					
9,000	29	309	-46.6		31	316	-41.6		26	310	-45.8		27	284	-64.2		23	300	-49.1		14	289	-51.7					
10,000	29	265	-53.8		31	272	-49.1		26	266	-53.1		24	243	-63.7		22	257	-55.1		13	248	-51.5					
11,000	27	226	-58.8		31	233	-56.8		26	228	-59.1		24	209	-60.8		22	219	-58.3		11	213	-49.1					
12,000	24	193	-59.6		31	199	-59.8		26	194	-62.4		22	179	-64.4		19	187	-63.5		10	182	-48.2					
13,000	21	164	-68.5		31	169	-66.7		22	165	-60.9		18	153	-69.1		16	169	-66.9		10	157	-47.7					
14,000	20	144	-67.1		30	144	-60.7		22	140	-58.8		18	132	-69.1		14	135	-66.5		8	135	-47.0					
15,000	20	119	-67.3		29	123	-63.2		22	119	-59.8		11	113	-69.2		12	115	-67.6		5	115	-47.4					
16,000	17	102	-65.5		25	104	-65.5		21	102	-60.4						8	98	-63.0									
17,000	13	87	-67.3		19	88	-66.4		14	86	-60.6																	
18,000					9	75	-66.9		5	73	-59.8																	

Altitude (meters) m. s. l.	Stations and elevations in meters above sea level																											
	Lakehurst, N. J.* (39 m.)				Medford, Oreg. (401 m.)				Miami, Fla. (4 m.)				Minneapolis, Minn. (263 m.)				Nashville, Tenn. (180 m.)				Norfolk, Va.* (10 m.)				Oakland, Calif. (2 m.)			
	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.	Number of obs.	P.	T.	R. H.
Surface	31	1,010	-0.9	75	31	969	8.5	77	31	1,016	16.9	90	31	986	-5.0	78	31	994	6.8	73	23	1,018	2.9	69	31	1,017	12.3	79
500	31	953	-2.9	75	31	958	8.9	72	31	960	17.1	82	31	956	-5.8	79	31	956	6.5	73	23	958	1.6	62	31	959	10.9	77
1,000	31	894	-4.3	75	31	902	8.3	62	31	905	14.8	75	31	897	-7.1	78	31	900	4.5	71	23	900	-0.8	58	31	903	9.7	64
1,500	31	839	-5.1	73	31	848	5.2	63	31	853	12.9	60	31	841	-7.8	72	31	846	3.1	66	21	845	-2.5	59	31	850	7.4	59
2,000	31	788	-6.5	69	31	798	1.9	65	31	803	11.3	52	31	789	-9.1	66	31	795	1.3	64	20	794	-3.7	57	31	800	5.1	54
2,500	31	738	-8.1	67	31	749	-1.2	62	31	756	9.1	46	31	739	-10.9	62	31	747	-0.8	63	20	745	-5.8	56	31	752	2.2	50
3,000	30	692	-9.9	65	31	704	-3.8	57	31	712	6.4	44	31	692	-13.1	60	31	701	-3.3	62	20	698	-8.4	54	31	707	-0.4	46
4,000	30	608	-14.9	64	30	619	-10.1	52	31	629	0.5	43	30	606	-17.4	58	30	618	-8.8	62	18	614	-13.5	49	31	623	-6.4	45
5,000	29	531	-20.8	60	30	543	-16.2	49	31	555	-5.7	44																

TABLE 2.—Free-air resultant winds based on pilot-balloon observations made near 5 p. m. (75th meridian time) during March 1940

(Directions given in degrees from North (N=360°, E=90°, S=180°, W=270°)—Velocities in meters per second)

Table with 15 columns of city names and 3 columns of wind data (Observations, Direction, Velocity) for altitudes from Surface to 14,000 meters. Cities include Abilene, Albuquerque, Atlanta, Billings, Bismarck, Boise, Brownsville, Buffalo, Burlington, Charleston, Chicago, Cincinnati, Denver, El Paso, Ely, Grand Junction, Greensboro, Havre, Jacksonville, Las Vegas, Little Rock, Medford, Miami, Minneapolis, Mobile, Nashville, New York, Oakland, Oklahoma City, Omaha, Phoenix, Rapid City, St. Louis, San Antonio, San Diego, Sault Ste. Marie, Seattle, Spokane, and Washington, D.C.

TABLE 3.—Maximum free air wind velocities, (M. P. S.), for different sections of the United States

[Based on pilot balloon observations during March 1940]

Section	Surface to 2,500 meters (m. s. l.)				Between 2,500 and 5,000 meters (m. s. l.)				Above 5,000 meters (m. s. l.)						
	Maximum velocity	Direction	Altitude (m.) m. s. l.	Date	Station	Maximum velocity	Direction	Altitude (m.) m. s. l.	Date	Station	Maximum velocity	Direction	Altitude (m.) m. s. l.	Date	Station
Northeast ¹	45.6	W	1,720	25	Boston, Mass.	50.8	W	4,340	21	Harrisburg, Pa.	60.0	W	6,840	21	Albany, N. Y.
East-Central ²	48.8	NW	2,440	10	Washington, D. C.	48.8	NW	4,920	25	Cincinnati, Ohio	68.0	WNW	11,640	1	Greensboro, N. C.
Southeast ³	37.0	WNW	2,500	15	Charleston, S. C.	40.8	WNW	3,040	15	Spartanburg, S. C.	70.0	WNW	10,260	9	Miami, Fla.
North-Central ⁴	40.1	W	1,370	29	Detroit, Mich.	50.8	NW	4,930	22	Fargo, N. Dak.	80.0	NW	7,730	22	Fargo, N. Dak.
Central ⁵	35.6	SSW	2,490	23	Springfield, Mo.	47.0	WNW	3,580	23	Indianapolis, Ind.	55.0	WNW	8,320	30	Omaha, Nebr.
South-Central ⁶	32.2	WNW	2,500	6	Amarillo, Tex.	48.6	W	4,090	6	Amarillo, Tex.	66.0	WNW	13,310	5	Abilene, Tex.
Northwest ⁷	28.2	W	1,750	14	Havre, Mont.	33.9	W	3,770	30	Butte, Mont.	55.0	NNW	10,380	11	Medford, Oreg.
West-Central ⁸	31.2	NNW	2,270	6	Pueblo, Colo.	40.8	WNW	4,880	5	Ely, Nev.	72.0	WNW	8,410	8	Redding, Calif.
Southwest ⁹	30.6	W	2,500	6	El Paso, Tex.	41.6	WNW	4,960	6	Albuquerque, N. Mex.	66.0	WNW	10,35,180	23	Las Vegas, Nev.

¹ Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, and Northern Ohio.
² Delaware, Maryland, Virginia, West Virginia, Southern Ohio, Kentucky, Eastern Tennessee and North Carolina.
³ South Carolina, Georgia, Florida and Alabama.
⁴ Michigan, Wisconsin, Minnesota, North Dakota, and South Dakota.
⁵ Indiana, Illinois, Iowa, Nebraska, Kansas, and Missouri.
⁶ Mississippi, Arkansas, Louisiana, Oklahoma, Texas (except El Paso), and Western Tennessee.

⁷ Montana, Idaho, Washington, and Oregon.
⁸ Wyoming, Colorado, Utah, Northern Nevada, and Northern California.
⁹ Southern California, Southern Nevada, Arizona, New Mexico, and extreme West Texas.
¹⁰ Data doubtful: A altitude based on assumption 105-gram pilot balloon rose at constant ascensional rate of 280 meters per minute when above an altitude of 960 m. above ground. Balloon observed for 126 minutes. Balloon may have floated at high altitudes thus giving erroneous results.

TABLE 4.—Mean altitudes and temperatures of significant points identifiable as tropopause during March 1940, classified according to the potential temperatures (10° intervals between 290° and 409° A.) with which they are identified (based on radiosonde observations)

Potential temperatures °A	Albuquerque N. Mex.			Atlanta, Ga.			Billings, Mont.			Bismarck, N. Dak.			Boise, Idaho			Buffalo, N. Y.			Charleston, S. C.			
	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	
290-299	2	7.0	40.5	1	7.8	43.0	4	6.8	43.0	1	7.0	46.0	2	6.4	42.5	8	6.8	48.5	1	7.9	44.0	
300-309	15	9.0	49.0	13	8.6	44.3	18	9.9	57.9	18	9.7	57.4	19	9.6	54.7	16	8.0	49.8	4	8.8	48.2	
310-319	23	10.4	55.3	30	10.4	54.8	22	11.0	62.0	13	11.1	63.8	30	10.9	60.6	12	10.7	60.8	17	10.6	58.9	
320-329	22	11.9	62.6	18	11.7	61.8	9	11.7	64.1	2	11.9	65.5	13	11.9	64.9	10	11.6	61.4	20	11.4	57.4	
330-339	8	12.4	63.2	3	12.1	58.3							2	12.8	66.0	2	11.0	52.5	8	12.0	60.0	
340-349	2	13.0	62.0												2	13.0	62.0	2	13.4	63.0		
350-359	3	14.0	65.0	4	13.9	64.2												1	14.4	65.0		
360-369	1	14.3	61.0	1	13.9	61.0							1	13.6	57.0	1	13.5	57.0	2	14.3	61.5	
370-379	3	15.3	65.0	2	15.0	65.5	1	13.5	56.0									2	14.6	61.0		
380-389	5	15.7	64.6	6	15.8	67.0							1	14.8	60.0	2	13.8	55.0	4	16.0	67.0	
390-399	1	16.0	64.0	8	16.2	66.4							2	15.8	63.0	2	15.8	60.5	6	16.5	67.8	
400-409																						
Weighted means		11.4	58.1		11.7	57.3		10.1	56.0		9.9	58.6		10.8	58.8		9.9	55.5		12.1	58.8	
Mean potential temperature °A. (weighted)	336.2			341.5			318.7			315.8			326.4			323.1			344.9			
Number days with observations	30			30			30			22			30			29			27			

Potential temperatures °A	Denver, Colo.			El Paso, Tex.			Ely, Nev.			Fairbanks, Alaska			Joliet, Ill.			Lakehurst, N. J.			Medford, Oreg.		
	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.
290-299	1	7.6	48.0				1	7.0	45.0	17	6.9	48.1	3	7.5	51.3	1	6.7	44.0	3	7.1	47.0
300-309	5	8.6	52.8				9	7.5	45.5	21	7.9	51.4	5	7.8	46.2	5	8.3	50.4	5	8.2	49.2
310-319	20	8.9	49.0	10	8.5	41.9	7	9.5	55.0	15	9.2	56.3	12	9.4	52.7	16	9.1	53.0	13	9.3	51.6
320-329	29	10.8	59.0	21	10.5	55.3	26	10.8	59.3	4	10.0	57.8	20	10.9	60.9	15	10.2	56.0	13	11.0	62.4
330-339	11	12.0	64.9	30	11.7	60.6	10	12.0	65.4				6	11.4	60.2	8	11.1	57.5	4	12.1	66.5
340-349	2	12.6	65.0	5	12.2	58.2	3	12.5	64.0				1	12.4	65.0	1	13.0	64.0	1	11.7	56.0
350-359				1	12.9	58.0	1	13.0	64.0				1	12.5	58.0	1	12.9	63.0			
360-369	1	12.8	55.0				1	12.7	55.0				1	12.4	52.0				1	13.5	59.0
370-379	1	14.6	63.0	5	14.9	66.2															
380-389	1	14.0	53.0	5	15.6	68.0	2	14.9	63.0				2	13.2	55.0	1	13.6	54.0			
390-399	1	15.6	64.0	4	15.8	66.5	1	15.4	62.2	1	13.5	50.0	1	15.4	62.2	1	15.1	60.0	1	15.4	62.0
400-409	3	15.7	60.0	8	16.6	66.6	4	16.1	63.7	1	14.1	49.0	1	15.9	61.0	2	15.4	60.0	2	15.9	62.0
Weighted means		10.7	56.8		12.1	58.6		11.1	58.9		8.3	52.1		10.4	56.7		10.2	55.0		10.4	56.7
Mean potential temperature °A. (weighted)	328.2			344.7			333.2			303.6			327.1			326.7			325.0		
Number days with observations	28			31			27			27			24			27			20		

TABLE 4.—Mean altitudes and temperatures of significant points identifiable as tropopause during March 1940, classified according to the potential temperatures (10° intervals between 290° and 409°A.) with which they are identified (based on radiosonde observations)—Con.

Potential temperatures, °A	Miami, Fla.			Minneapolis, Minn.			Nashville, Tenn.			Oakland, Calif.			Oklahoma City, Okla.			Omaha, Nebr.			Pensacola, Fla.		
	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.
290-299	1	7.2	36.0	3	6.5	45.6	1	8.2	50.0	1	8.2	46.0	1	5.9	37.7	10	7.8	46.6			
300-309	1	8.8	46.0	9	9.1	48.8	1	9.1	49.4	6	9.0	49.3	6	9.1	49.0	21	9.4	54.2	2	10.2	56.5
310-319	7	8.9	36.9	20	9.3	54.6	12	9.1	49.4	21	10.8	59.0	26	10.5	56.3	21	10.7	59.4	4	9.8	49.8
320-329	28	10.9	51.7	2	11.8	65.5	16	10.4	58.6	23	12.0	64.2	17	11.6	61.2	10	11.2	58.5	13	11.2	55.8
330-339	17	12.3	57.5				7	11.6	56.6	9	12.8	64.6	7	12.6	63.9	3	11.9	56.7	2	12.5	60.6
340-349	13	13.2	60.3				2	13.1	61.0	1	12.2	50.0				1	11.6	48.0	1	12.5	57.0
350-359	12	14.4	66.1							2	13.6	61.5	2	13.6	61.5	2	12.8	54.5			
360-369	7	15.2	67.9				1	13.8	60.0	2	14.4	62.0	3	14.4	61.0						
370-379	10	16.1	72.3				4	14.7	59.8	1	15.5	66.0	3	14.8	62.3	3	14.5	60.0			
380-389	6	16.8	72.2				3	14.9	58.3	1	15.6	66.0	3	15.6	64.0	2	15.5	60.0	1	16.2	72.2
390-399	6	17.3	73.8	1	14.2	52.0	2	16.4	66.0	5	16.1	63.2	5	16.6	67.4	2	15.4	58.5	1	17.9	79.0
400-409	6	17.3	73.8				2	16.4	66.0	5	16.1	63.2	5	16.6	67.4	2	15.4	58.5	1	17.9	79.0
Weighted means		13.1	59.4		9.6	55.4		11.3	56.0		11.9	60.8		11.7	58.7		10.5	55.7		11.5	53.0
Mean potential temperature °A. (weighted)	355.0			317.6			338.4			338.3			340.2			329.0			336.9		
Number days with observations	31			27			27			30			28			29			17		

Potential temperatures, °A	Phoenix, Ariz.			St. Louis, Mo.			San Antonio, Tex.			San Diego, Calif.			Sault Ste Marie, Mich.			Spokane, Wash.			Washington, D. C.		
	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature °C.
290-299																					
300-309	2	6.4	32.5	4	8.3	49.8							5	7.1	49.2	4	7.1	47.2			
310-319	5	9.1	48.2	15	9.3	52.8	3	8.2	37.0				18	8.0	49.9	8	9.4	51.9	5	7.9	47.6
320-329	14	10.8	55.5	20	10.8	59.0	13	10.2	51.9	10	10.8	58.3	6	10.4	59.0	20	9.2	52.8	13	9.5	54.4
330-339	17	11.6	59.4	8	11.4	61.1	27	11.3	55.3	9	11.7	61.2	1	12.4	70.0	7	11.7	63.6	7	10.2	55.9
340-349	6	12.4	60.5	1	12.7	66.0	14	12.3	59.4	7	12.7	64.1				4	11.6	62.0			
350-359	2	13.0	62.5	2	12.4	56.0	5	13.5	63.0	1	14.2	68.0									
360-369				1	12.9	59.0	5	13.9	60.6												
370-379	1	13.1	52.0	1	13.1	54.4	4	14.6	65.8				2	12.9	51.2						
380-389	1	14.7	59.0	2	14.0	57.5	4	15.4	66.2							1	13.9	55.0			
390-399	2	15.6	65.0	2	15.1	62.5	9	16.1	66.8	4	16.0	68.2									
400-409	2	16.2	64.5	4	16.0	61.8	6	16.4	66.3				1	15.7	62.2						
Weighted means		11.5	56.8		11.1	57.3		12.6	58.4		12.1	61.3		9.3	54.9		10.0	57.3		9.7	54.6
Mean potential temperature °A. (weighted)	337.4			334.4			350.8			340.6			315.6			318.9			318.2		
Number days with observations	26			26			31			16			28			28			19		

RIVERS AND FLOODS

[River and Flood Division, MERRILL BERNARD, in charge]

By BENNETT SWENSON

The outstanding features during March 1940, from the standpoint of floods, were: First, the occurrence of two major floods in the Sacramento Valley occurring within an interval of approximately a month. The first had its beginning the latter part of February and continued into the first week of March while the second began the latter part of March. A report of the first of these floods appears elsewhere in this REVIEW as a separate article; the second flood will be reported at a later date.

Second, the constant threat during the month of floods in the Northeast due to the presence of considerable snow on the ground. No appreciable flooding materialized until the last of the month when floods developed principally in the Susquehanna and Allegheny River basins.

A number of other floods occurred during the month but were mostly of light to moderate degree.

Precipitation during the month was generally considera-

bly above normal in the upper Mississippi and middle Missouri basins, the central Rocky Mountain region, the Northeast, and the middle Pacific slope drainage area. Temperatures were below normal in the eastern half of the country and above normal in the western half.

St. Lawrence drainage.—Moderate flash floods occurred in the Red Cedar and Flint Rivers during the latter part of March. Persistent cold weather up to March 28 had prevented any appreciable run-off and the streams were abnormally low. A sharp rise in temperature on the 29th melted the remaining snow cover and started the break-up of ice in the streams. Sudden rises in the headwaters and ice jams caused moderate overflow in low places. No appreciable damage resulted but 2 lives were lost.

An ice gorge at Napoleon, Ohio, on the Maumee River, caused flooding when the river backed up to a stage of 13.4 feet at that place on March 5.